Space Weather Technical Forecast

Issued on Saturday, 03 September 2022 at 00:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares (R1-R2 Blackouts). G1/G2 Minor/Moderate Geomagnetic Storm expected on day 2 (4th Sep).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low but slowly increasing, with C-class flares becoming stronger and more frequent. Of the four active regions on the visible disc, AR3089 remains the largest and most complex region. This region continues to grow, with proliferation of spots, but has somewhat simplified, now Eai/Beta-Gamma. AR3092 in the far SE has shown little change and is relatively simple (Bxo/Beta). The new region in the southeast quadrant has now been numbered as AR3093, however it remains small magnetically simple. Another sunspot region has recently appeared in the northeast quadrant, AR3094. Being close to the limb, its analysis is difficult but it currently seems to be a small and unipolar group.

A filament eruption was observed in the southeast (to the west of AR3093) around 1845 UTC. This will be analysed once sufficient coronagraph imagery becomes available. No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was indicative of weak coronal hole influences. The solar wind speed remained slightly elevated but was erratic, fluctuating between 330-370km/s. The density was largely average but increased through the period to finish above average, with a peak of 18 ppcc at 02/2327 UTC. Total interplanetary magnetic field strength was largely weak but increased after 02/1600 UTC, reaching 8nT at the end of the period. The north-south component, Bz, was fluctuating mostly between -5 and +4nT but became increasingly negative after 02/1600 UTC, reaching -8nT at times. The Phi angle was largely negative (towards the Sun) but switched to a positive orientation (away from the sun) after after 02/1600 UTC, most likely indicating a connection with the HSSS from CH19. Geomagnetic activity was Quiet with one provisional Unsettled interval between 02/2100-2400 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured at GEOS-16 was at background levels. The high energy electron flux (greater than 2 MeV) remained at background to moderate levels. The 24-hour integrated electron fluence remained well below the Active threshold (1e8 integrated pfu), with 3.11e6 integrated pfu observed at 03/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain largely Low, with an ongoing chance of Moderate flares at times, mostly from AR3089. However, a new region may rotate onto the northeast limb on day 3 (05th), potentially increasing the probabilities of a significant flare.

Solar Wind / Geomagnetic Activity: Solar winds are expected to remain slightly elevated on day 1, under small coronal hole influences. They should then become elevated or perhaps

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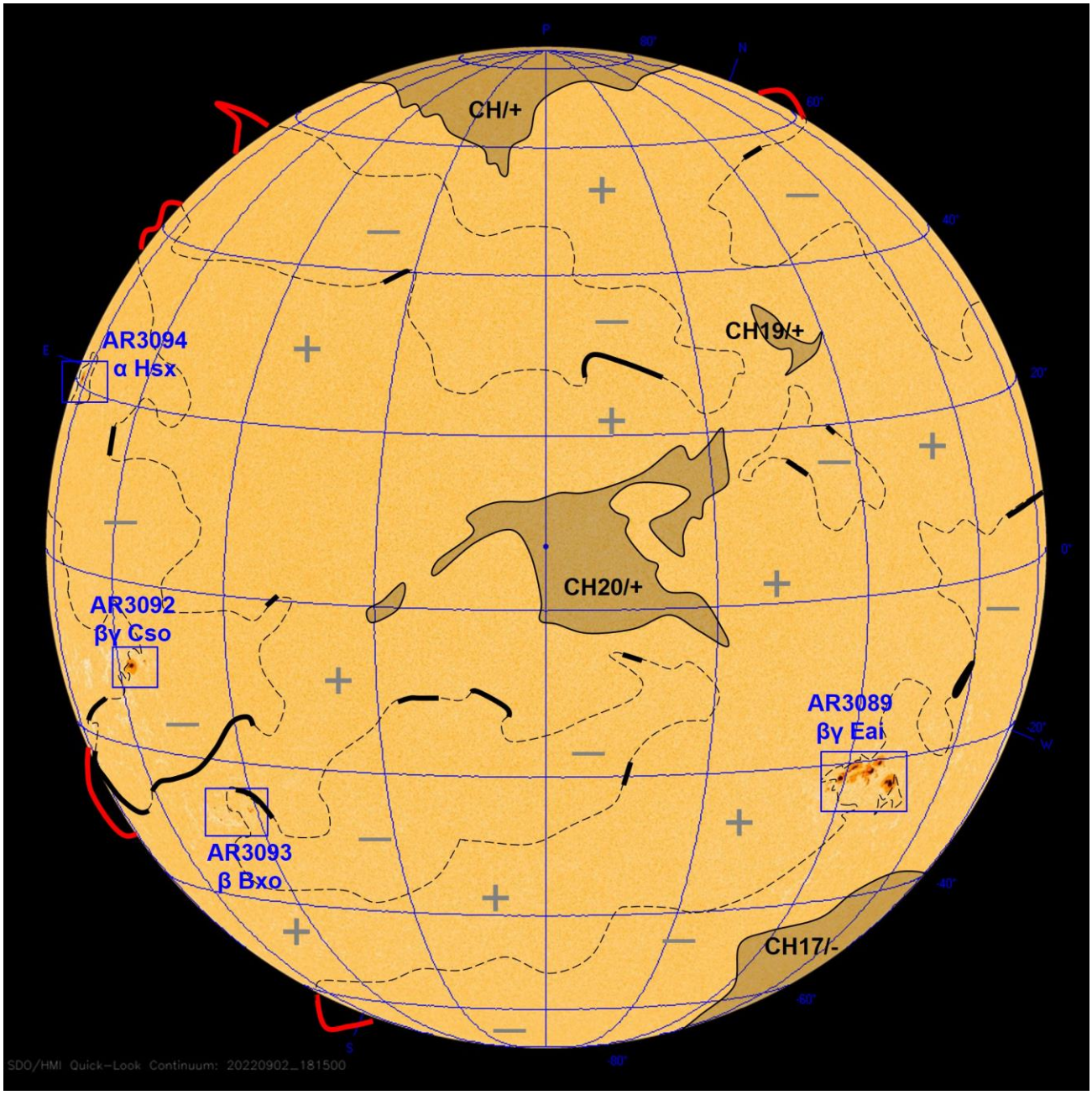
strong on day 2, due to the connection with the larger CH20/+. Geomagnetic activity is therefore expected to be Quiet to Unsettled on day 1, but Unsettled to Active with a few G1/G2 Minor/Moderate storm intervals on days 2 (04th), most likely generated by the preceding CIR (co-rotating interaction region). Geomagnetic activity then slowly returning to Quiet and Unsettled levels on days 3 and 4 (05th and 06th).

Energetic Particles / Solar Radiation: High energy protons (greater than 10 MeV) are expected to remain below S1/Minor radiation storm levels. The high energy (greater than 2 MeV) electron flux is expected to be at background levels initially but to increase over the following days, with an increasing chance of exceeding high levels. The corresponding 24 hour fluence is expected to display a sharp rising trend from day 2 (04th) onwards, with a chance of exceeding the Active threshold on day 4 (06th).

Figure 1. Solar Analysis Valid 02/2000 UTC.



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Met Office Space Weather Technical Forecast

Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A marked filament eruption was observed leaving the sun on 30 August. The CME that followed may give a glancing blow at Earth in the early hours of the 03rd (day 1), however confidence is low regarding this.

Solar winds are expected to be slightly-elevated initially, under the weak influence of CH19/+. This coronal hole is small and precedes the much larger CH20/+, a recurring feature that generated solar wind speeds close to 600 km/s and a couple of minor/moderate storm intervals on the last rotation. With the autumn equinox approaching and a coronal hole slightly larger this time round, connection with its high speed stream should be very effective and the impact at Earth equal if not stronger.

Geomagnetic activity is therefore expected to be Quiet to Unsettled on day 1, but Unsettled to Active with a few G1/G2 Minor/Moderate storm intervals on days 2 (04th), most likely generated by the preceding CIR (co-rotating interaction region). Geomagnetic activity then slowly returning to Quiet and Unsettled levels on days 3 and 4 (05th and 06th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	80	50	5
Strong	G3	No	1	10	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

NIL

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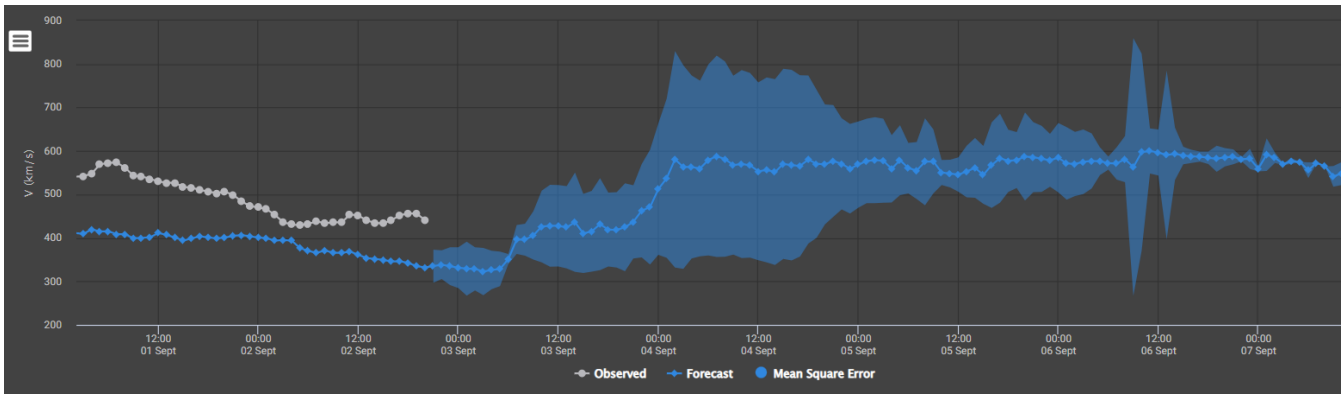
Figure 2: Solar Wind Persistence Model (SWPM) considered to provide good guidance



Radio Blackouts - X-Ray Flares:

Solar activity has been Low but slowly increasing, with C-class flares becoming stronger and more frequent.

Of the four active regions on the visible disc, AR3089 remains the largest and most complex region. This region continues to grow, with proliferation of spots, but has somewhat simplified, now Eai/Beta-Gamma. AR3092 in the far SE has shown little change and is relatively simple (Bxo/Beta). The new region in the southeast quadrant has now been numbered as AR3093, however it remains small magnetically simple. Another sunspot region has recently appeared in the northeast quadrant, AR3094. Being close to the limb, its analysis is difficult but it currently seems to be a small and unipolar group.

Solar activity is expected to remain largely Low, with an ongoing chance Moderate flares at times, mostly from AR3089. However a bright flux region is visible on the EUVI/AIA 195 imagery, indicating the presence of an active region. This region may rotate onto the northeast limb on day 3 (05th), potentially increasing the probabilities of a significant flare.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	25	25	25
Very Active	R3 to R5 X Class	No	1	1	1	1

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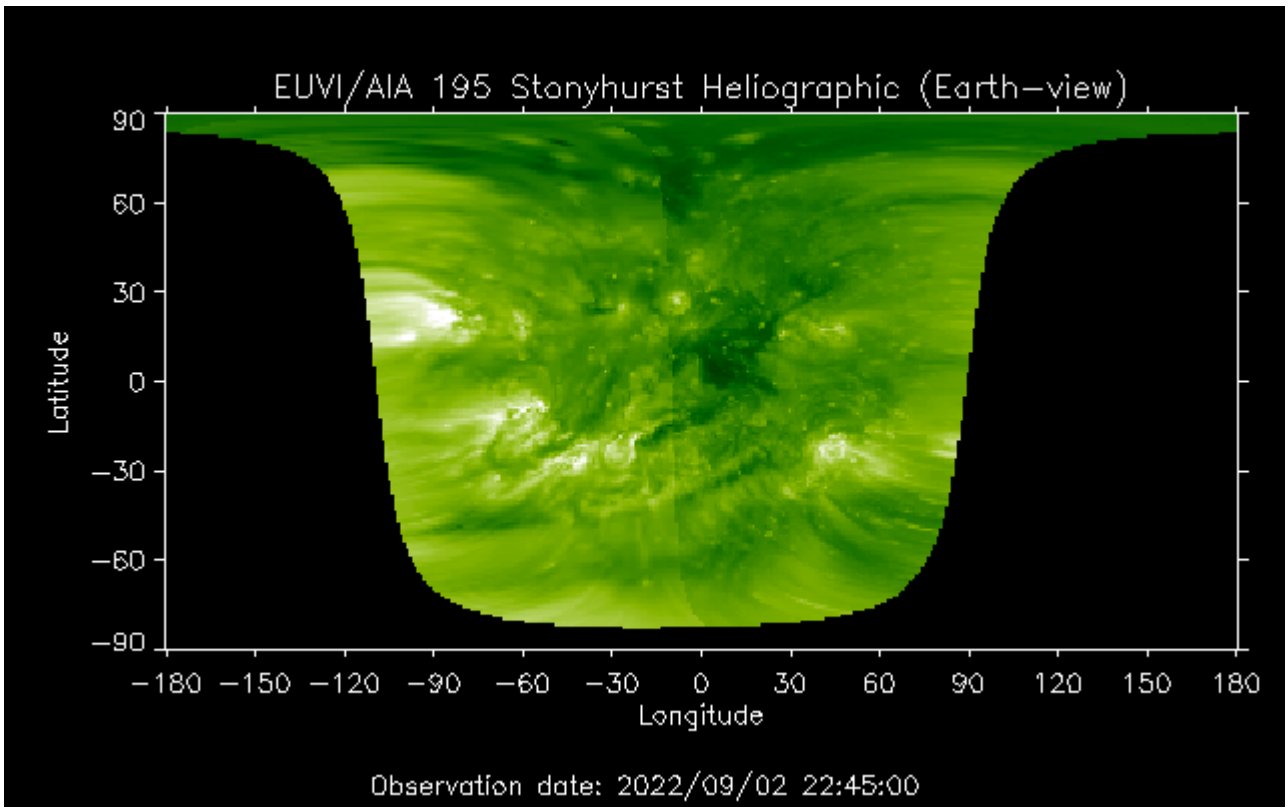
Figure 3: Latest X-ray flare activity, as observed by GOES-16

Figure 4: Latest EUVI/AIA 195 imagery, showing a bright flux region near 110 degree East



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) remains at background values. Despite and apparent stability, AR3089 (Eai/Beta-Gamma) continues to present a slight chance of a proton event at Earth, should there be any significant flaring. This risk will continue as the region rotates further across the southwestern quadrant.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	3	3	3	3
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) is currently at background levels, with no significant enhancements expected initially. The arrival of the fast speed stream originating from CH20/+ will most likely re-populate the Van Allen belts on day 2, so much so that the electron flux is likely to rise and exceed high levels during the diurnal peak on day 3, this rise perhaps becoming more permanent on day 4.

The corresponding 24 hour fluence is expected to display a sharp rising trend from day 2 (04th) onwards, with a chance of exceeding the Active threshold on day 4 (06th).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	10	30	50
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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Figure 5: Electron flux from the previous rotation, a similar trend is expected this time round.

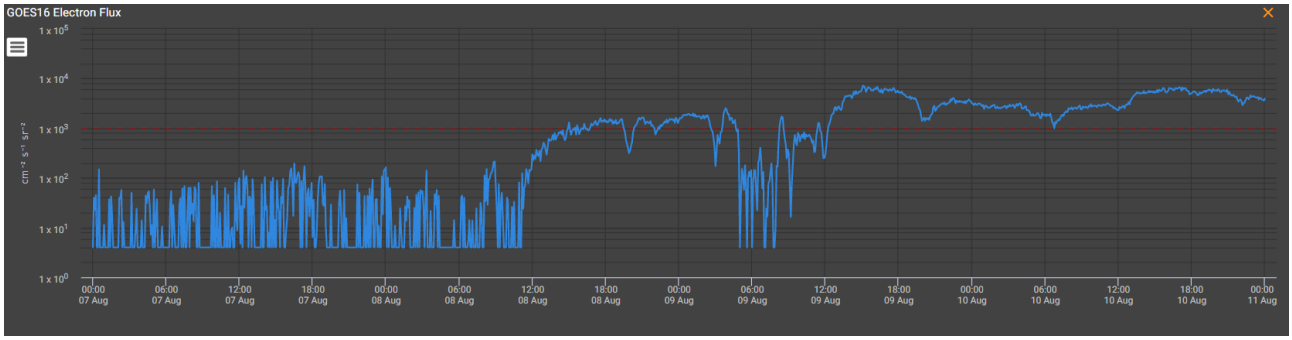
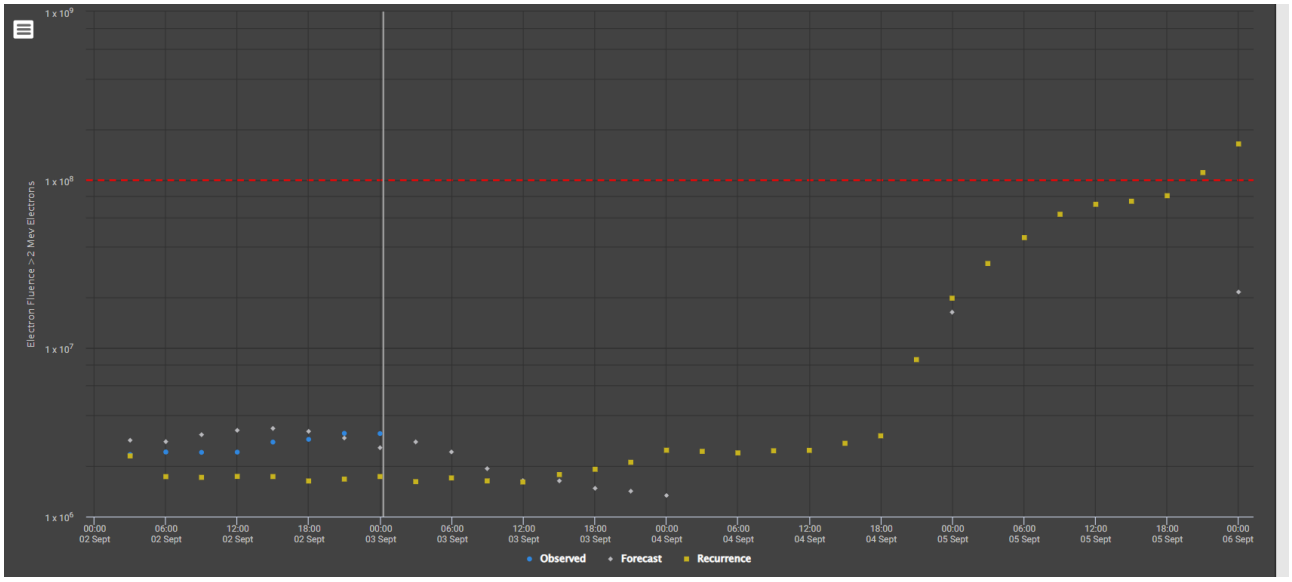


Figure 5: Latest REFM, considered to slightly under-estimate the expected fluence



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